

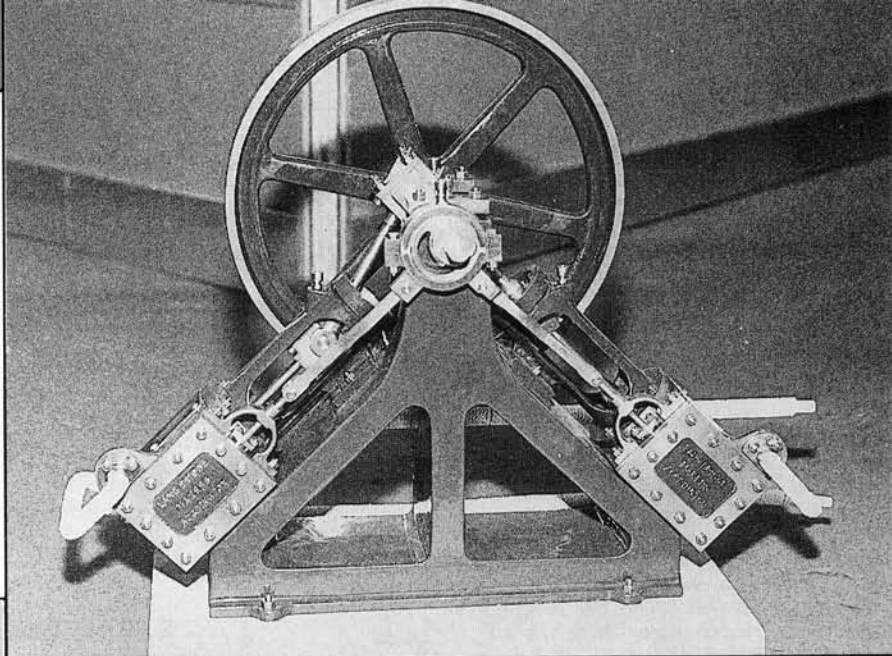
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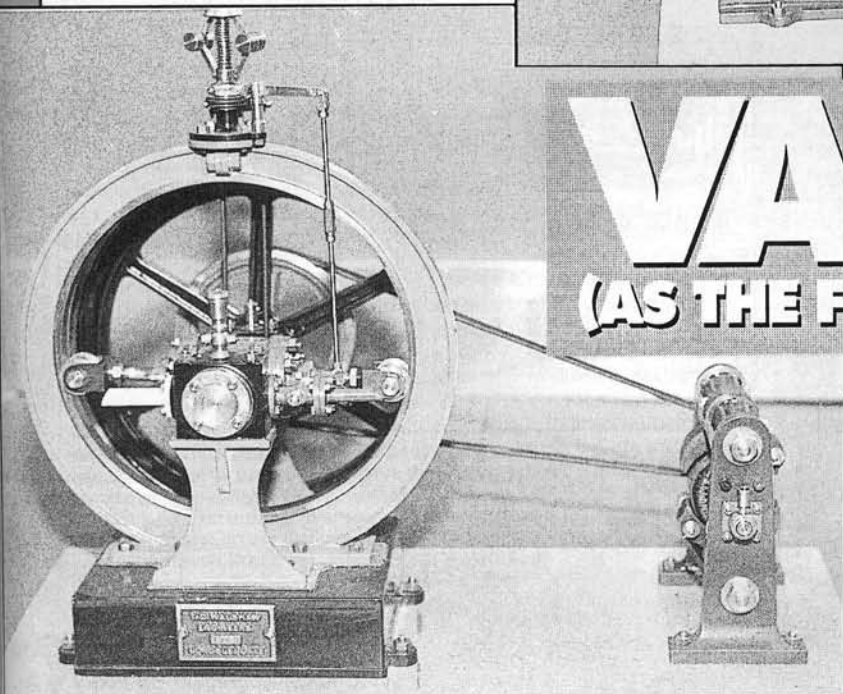
As well as being used to drive locomotives and traction engines – in other words, engines that moved – steam was also massively employed to power the Industrial Revolution in all kinds of applications. It was the age of the stationary steam engine...

At right, a diagonal steam engine; they were popular in boats where their design helped keep the c.g. low.

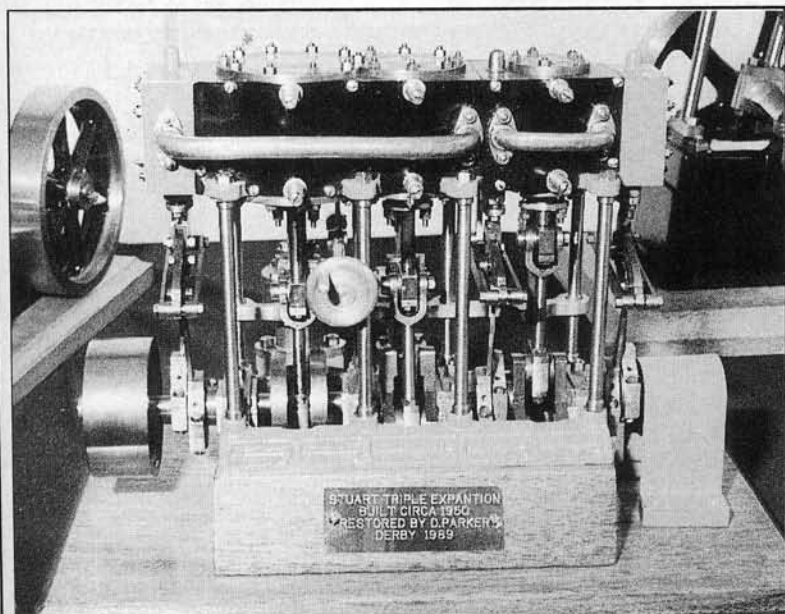


VAPEUR

(AS THE FRENCH WOULD SAY)



Above, an unusual model based on Coombes' Rotary Engine of 1857 by T.D. Walshaw. Below, a well made example of a triple expansion engine; the real things were, again, popular in boats.



There can be no doubt that the most popular form of power for the model engineer is steam. There are many reasons, one supposes, for this. Steam engines are a basically simple form of propulsion and can be more easily made than internal combustion engines in model form. For many of the older modellers steam was the prime mover in their young days, although sadly this is a rapidly diminishing band of enthusiasts.

Steam has been used to power all sorts of machinery. For example there are stationary engines which were used to supply power to factories and to pump water. They also powered the lifts which took miners into the mine shafts, drove fairground equipment and even powered the mechanical organs.

Steam was used to power road vehicles such as traction engines, cars and lorries. It was used in boats and, of course, on the railways, this latter probably being the best known use of all. One only has to look at the many preserved railway lines and steam road vehicles to realise that there are plenty of enthusiasts for the full-sized artifacts as well as for using it as a modelling medium.

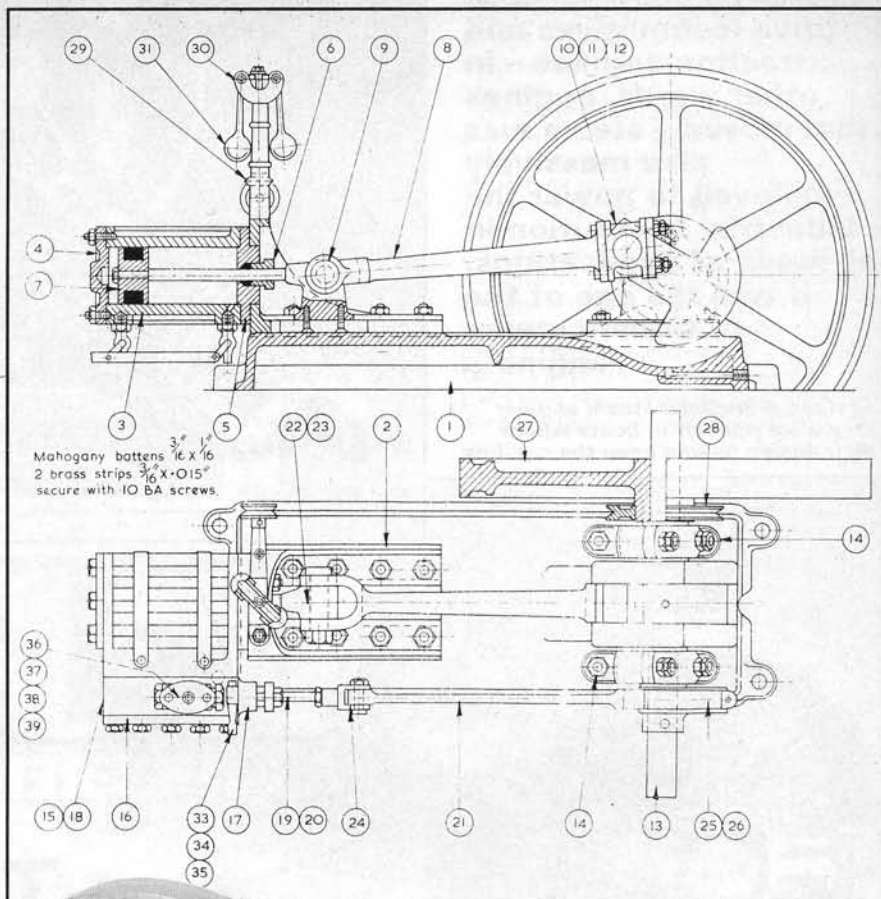
Nobody is sure exactly when steam was first used to provide power. When the writer was at school, too many years ago now to bear thinking about, he was taught that James Watt was the man responsible for its use, having sat and watched the lid lift on a kettle under the increased pressure caused by the steam when it boiled. He may well have watched the kettle and we will never know for sure whether this sparked his enthusiasm but, make no mistake about it, he did a great deal to further its use as a power source. However he most certainly did not invent

the steam engine, and he was not the first to use it as a means of getting power.

There have been many claims and counter claims, regarding who was the first to harness the power of steam and it seems likely that a man named Hero was the first. Early pictures show his invention as a form of steam turbine. Again we cannot be exactly certain what it looked like as some of the drawings are rather fanciful. It would appear to have consisted of a sphere with pipes out of the side and some form of bearing top and bottom.

The sphere was part filled with water and heated underneath until steam was produced. This ejected from the pipes and the result was that the sphere rotated. Whether it was ever adapted to any practical purpose we shall never know; there is no reason why it should not have been and models of it have been made and have worked successfully – in fact, we present the drawing for one elsewhere in this publication. It was, in fact, a steam turbine of sorts and steam turbines are still used to this day. Our power stations which supply electricity, whether coal, gas or nuclear fired, are only heat sources for driving steam turbines...

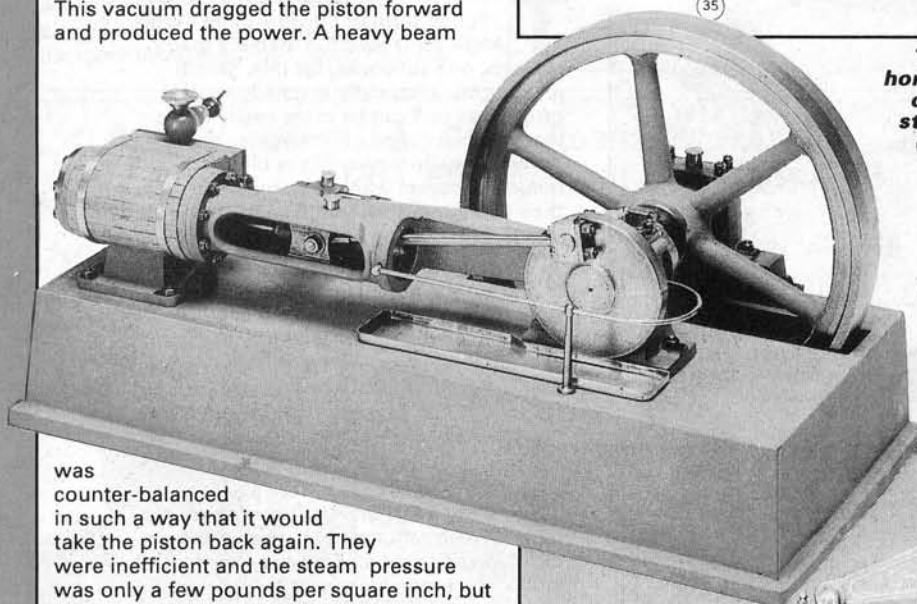
Many years after Hero come reports of the use of steam engines of a sort being used for various purposes, the first well documented ones for pumping water from mines, etc. They worked by heating the cylinder with steam and then creating a vacuum at the bottom by rapidly cooling it. This vacuum dragged the piston forward and produced the power. A heavy beam



This popular Edgar T. Westbury design for a horizontal mill engine (above) is one of dozens of commercial plans available for stationary steam models. Named 'Unicorn', the drawing (of which this is only a portion) is available, among many others, from Model Engineer Plans Service at the same address as the publishers of this magazine.

Left, a typical single cylinder horizontal steam engine of the type built by Robey of Lincoln. Drawings and casting are available from Southworth Engineering.

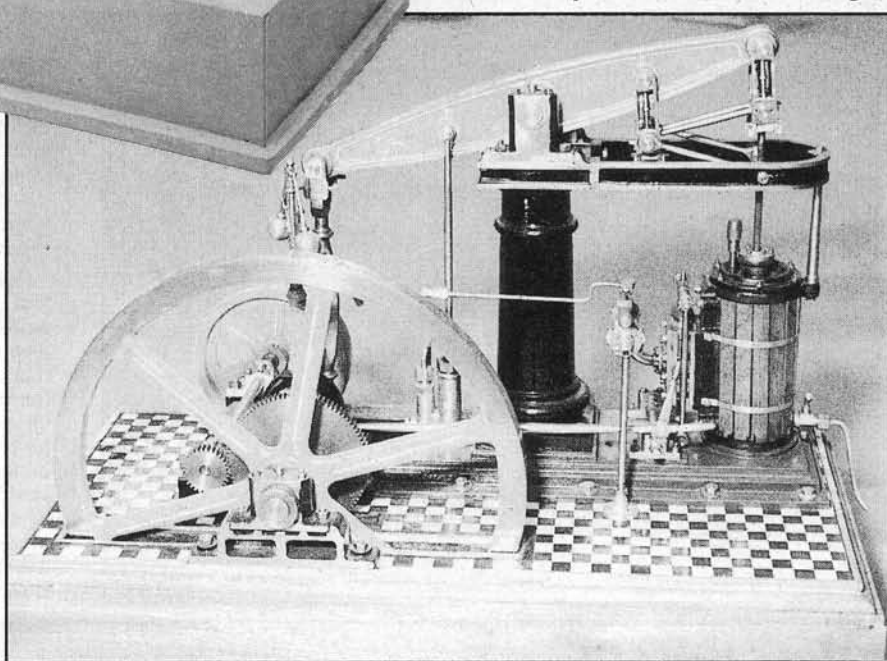
Below, the beam engine is always a favourite among model engineers; note compensating gear on beam to allow piston rod to travel straight.



was counter-balanced in such a way that it would take the piston back again. They were inefficient and the steam pressure was only a few pounds per square inch, but they saved a great deal of hard labour.

Mainly as a result of the invention of the crank it became possible to allow the actual steam working at a higher pressure to do all the work and from then on progress was rapid. There were still beam engines, the power now being transferred to a crank and so giving a rotary motion, but there were also a large variety of other types as well. So it was to some extent the crank that started the progress and model engineers will find that usually an essential part of their model will be a crank of one sort or another.

Most factories, mills, etc., were subsequently powered by steam engines and the power was transmitted via shafts and belts. One problem had always been building suitable boilers, but as improvements were made in these and



pressures increased, before long the engines, which until then were massive, could be built smaller and so it became possible to fit them into forms of transport. The history of the various forms of transport is fascinating but it is not the purpose of this publication to deal with the historic side. The point is that, not only were smaller engines being constructed, but the number of types increased as well, until there was a whole range of engines available for use.

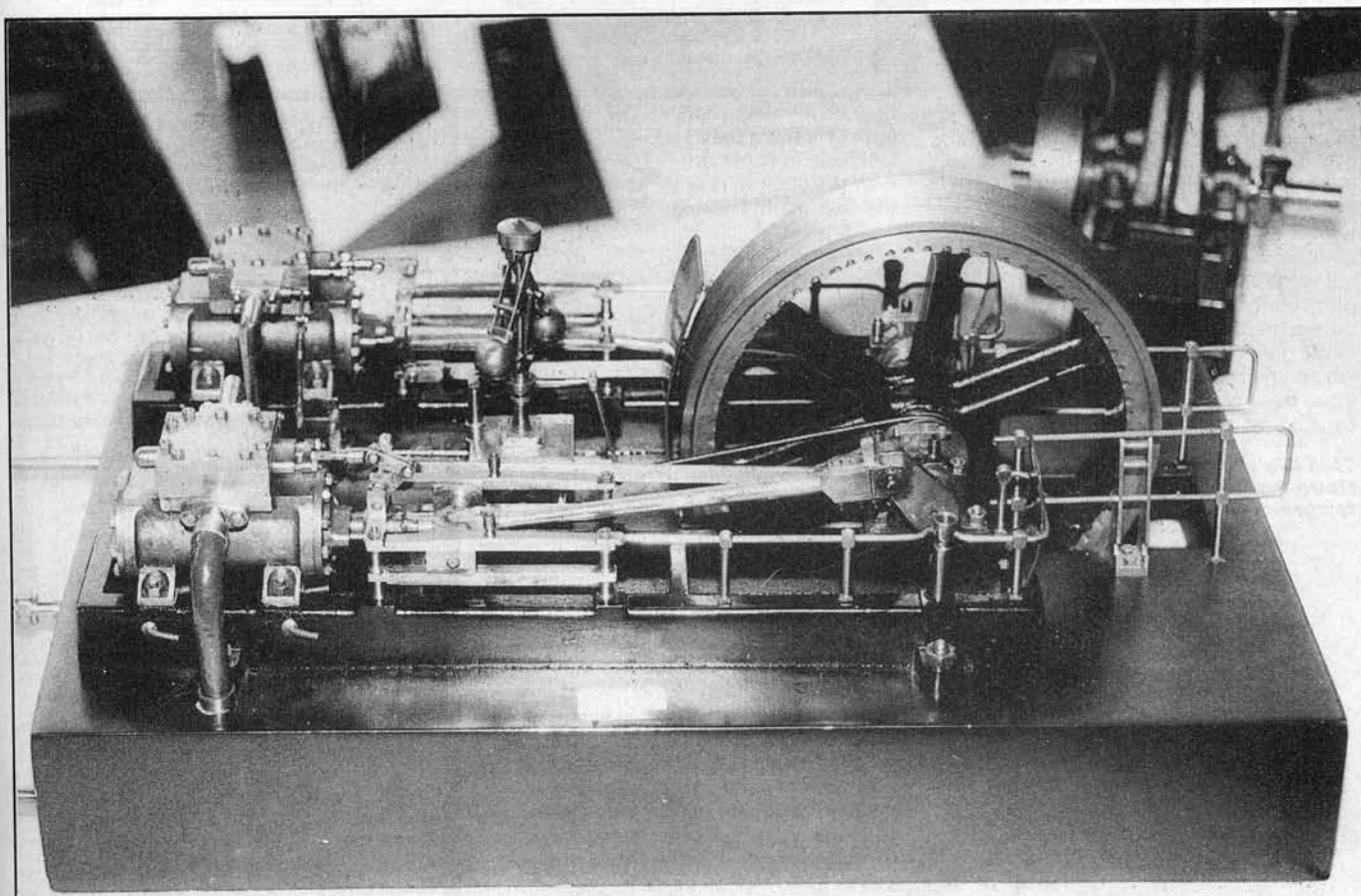
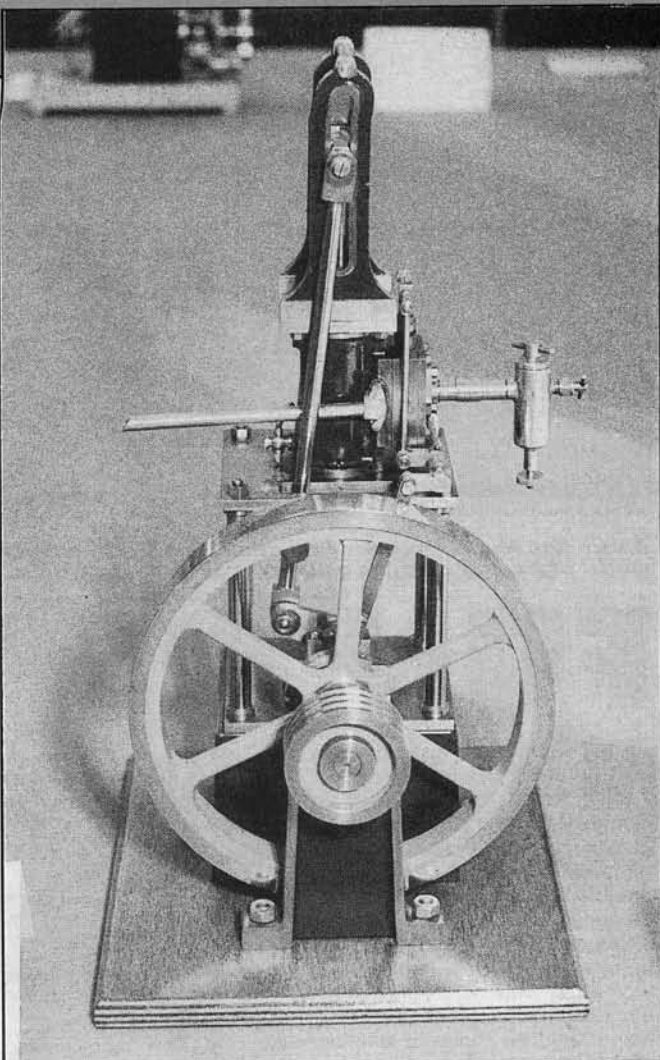
Many experiments were carried out with the valves and in the shape of the engine itself, the basic principle remaining the same. It is this fascinating and diverse range of shapes and methods of working that is of interest to model engineers as it enables us to make a whole range of models driven by steam which are only really variations on a theme. It provides a chance to make very simple models suitable for a beginner with virtually no knowledge whatever of either steam engines or engineering practices, right up to models of the largest and most efficient locomotives. Thus, if we acquire knowledge of this form of power alone we have before us a means of making as many models as we would ever be able to produce in a lifetime without actually repeating ourselves!

The use of steam to drive locomotives, road vehicles, etc., in models is dealt with in other chapters. Here it is worth looking at some of the wide range of models of stationary engines to see how various types were designed for different purposes. Whilst models are unlikely to be made to perform a particular function, various designs may be preferable to a

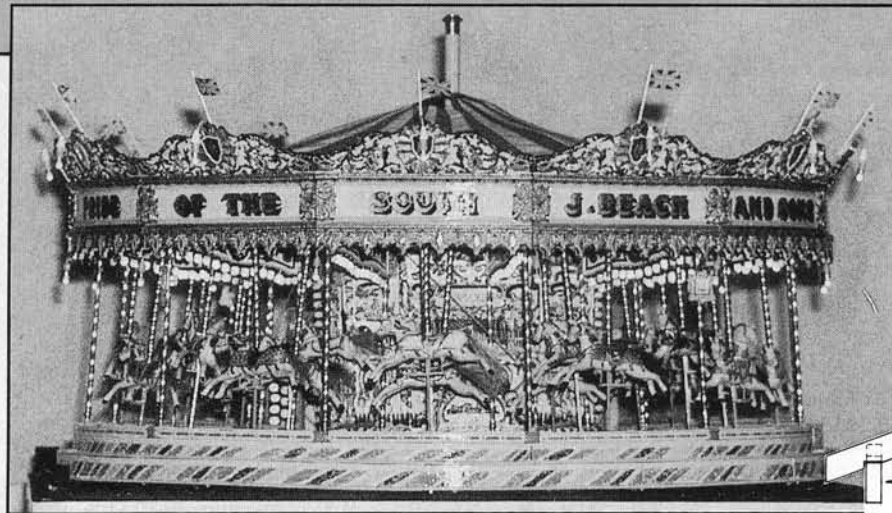
This 'table' engine is a good choice for the beginner as a first steam modelling project.

particular modeller for one reason or another.

Most of the models shown are to standard designs for which drawings and castings are available but this aspect of modelling does lend itself particularly to the modeller who likes to be an individual and many stationary engines can be constructed from old engravings and without the need for castings.



Built by F. Brown of Scunthorpe, this is a very fine example of a two-cylinder horizontal steam engine. As you can see, stationary steam offers endless modelling possibilities, all the way from the very simple to the highly complex.



A very fine Model Engineer Exhibition Gold Medal-winning model of a set of old-time gallopers built by John Maundrell

Although there may be less of the real things about these days (or maybe because of the fact), fairground models are increasing in popularity. The range of subjects is vast and the number of commercial fittings and plans is growing...



FUN OF THE FAIR

Modelling fairgrounds is, in a way, like modelling trams. There is an element of model engineering involved whilst, at the same time, there is also a considerable amount of other types of modelling incorporated as well. This side of the hobby is very popular and the popularity is increasing. Much of this is due to a man named Vic King who has now retired. He started marketing drawings and some parts many years ago and this enabled those with less knowledge to start building fairground models.

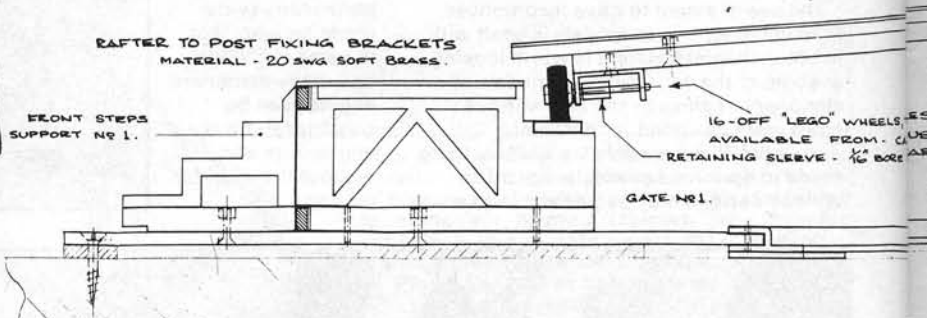
In spite of the obvious increase in interest in the subject, to many, how to make a start and where to get suitable drawings and supplies remains something of a mystery. The range of prototypes available for modelling in the fairground range is vast and includes some quite simple things as well as some that are complicated.

If we think of a full-sized fairground, particularly a large one, there are many different types of rides, this being the name given to the various attractions on which one takes a ride. Over the years these have changed and, with a few exceptions, are now very different than

This is a model made from a kit by Doug Roseman of a typical fairground stall.



A casting of a decorative figure, available from Doug Roseman.

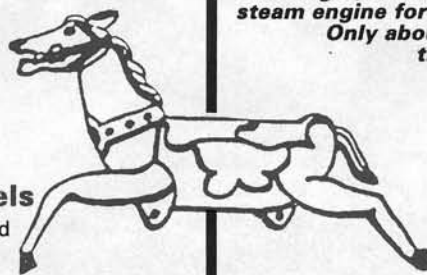


they were many years ago. One thing they still have in common with the older fairs is the colour and lighting which gives excitement to the fairground.

Choice of models

The potential fairground modeller has a wide choice from which to model. Drawings are available from two main suppliers for virtually all the rides one would wish to build. They can be built in a variety of scales which means that the size can be regulated to the facilities and room available. Generally individual working models are constructed in 1/24th, 1/16th, or 1/12th scale but occasionally larger models are built. When working in these scales it is usual to take one particular prototype and to work on that.

Parts are, however, now available for those wishing to model a complete fairground in much smaller scales, from a number of suppliers. Usually in this case one would purchase a kit of particular attractions and assemble a complete circus. If, for example, the wish was to build a very comprehensive model to a scale of 1/76th, then it would when finished take up about six feet by



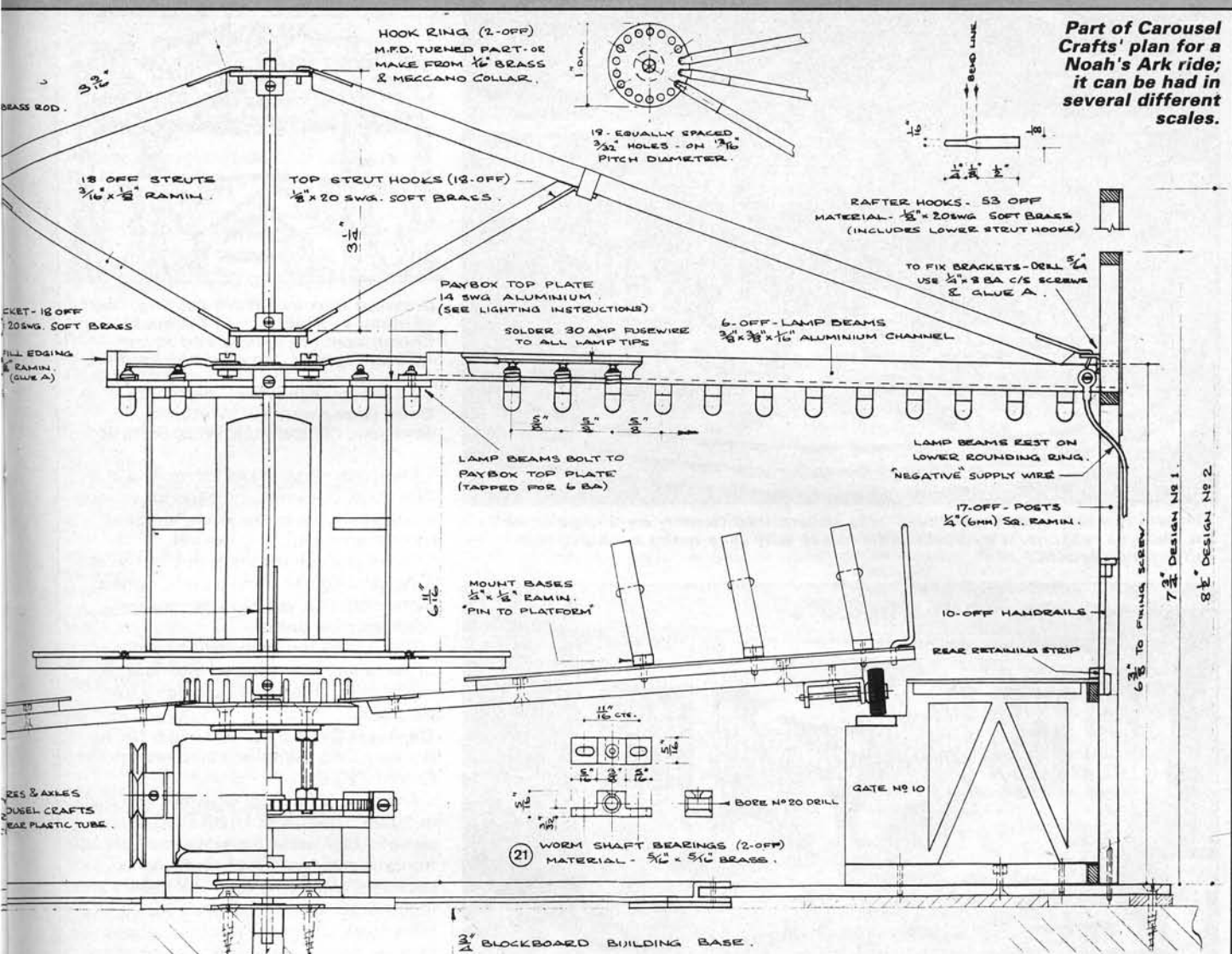
At right, an excellent example of a steam engine for a fairground organ. Only about three inches high, this shows the model engineering side of the hobby at its best. The model is very difficult to construct, the cylinder and stand being two castings split down the centre and the cylinder having a blind bore.

four feet and would be a most attractive model. The kits are, generally speaking, white metal and etched brass and are reasonably easy to assemble.

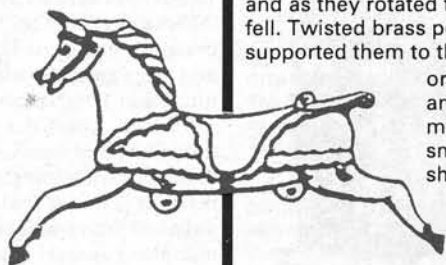
Individual models

When an individual model is being built construction will centre on that alone; the drawings marketed contain a wealth of constructional information as well. The catalogues of both firms involved with these larger models also give details of where basic materials can be obtained. Take, for example, a roundabout as it is frequently referred to, and a design which is amongst the most popular.

All readers will know that this is a machine that has a number of pieces on which customers can sit and to the accompaniment of music will go round and round!



**Drawings of horses,
available in 1/24th
and 1/12th scales
from Carousel Crafts.**



The large and older ones were very elaborate affairs and known as 'gallopers'. The general seat was a horse with large sized cockerels included at intervals. Usually the horses would be three abreast and as they rotated they gently rose and fell. Twisted brass poles known as 'olivers' supported them to the roof of the ride. An organ would play music and both organ and machine were driven by small steam engines. A showman's engine would supply electricity for the lighting.

Some of these held all over the country. Anyone hesitant about the construction of things like the horses and cockerels can obtain these either as rough castings for finishing by the builder, as more completed models, or alternatively complete and ready for painting. The same applies to many of the other component parts of different types of rides.

gallopers can still be seen at steam rallies

Getting up to date

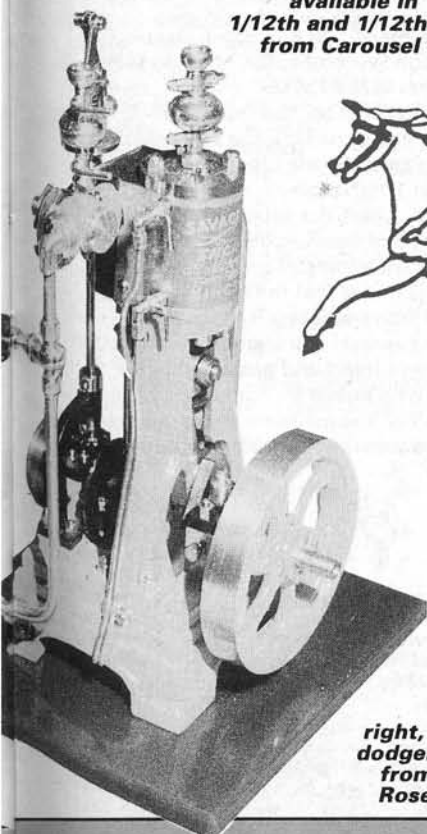
For those wishing to model more up-to-date fairgrounds the steam engine has long since been replaced with diesel generators, and power is likely to be

supplied to the rides by a large electric motor. Another feature of a fairground, whether old or modern, is the fact that they were mobile and travelled the country. This means that, apart from the rides, there are many other things worth modelling — the vehicles used for towing being an example, traction engines as originally used giving way to large diesel tractors. The owners and workers frequently use elaborate caravans as living accommodation and these too lend themselves to model making.

Also worth modelling are the various organs. Whilst some were designed only for being incorporated in the rides many were on trailers and are very colourful with moving figures.

Construction

The actual moving parts of the rides are comparatively simple model engineering although one of the suppliers, Doug Roseaman, is even willing to take on this



**Far
right, model
dodgem cars
from Doug
Roseaman.**





The still familiar 'merry-go-round' was known traditionally as 'the galloper', for obvious reasons. It's not difficult to see why they make such popular fairground models.



Drawing of organ front casting, one of many available from Carousel Crafts, some in 1/16th and some 1/24th. Figures can also be supplied.

Doug Roseaman. 101 Westbrook, Bromham, Chippenham, Wilts. SN15 2EE.

Complete range of kits for models in 1/76th scale. Drawings and parts for various models in larger scales. All lighting components, including booklet.

Organ and generator kits in 1/24th scale. A range of figures, carved parts, turned parts, cloth tilts, etc. Models are also constructed to order.

The above represents only a small part of the range. A telephone helpline is available for those making models from the plans.

Carousel Crafts. Willow Lodge, 10 The Rookery, Orton Wistow, Peterborough, Cambs. PE2 6YT.

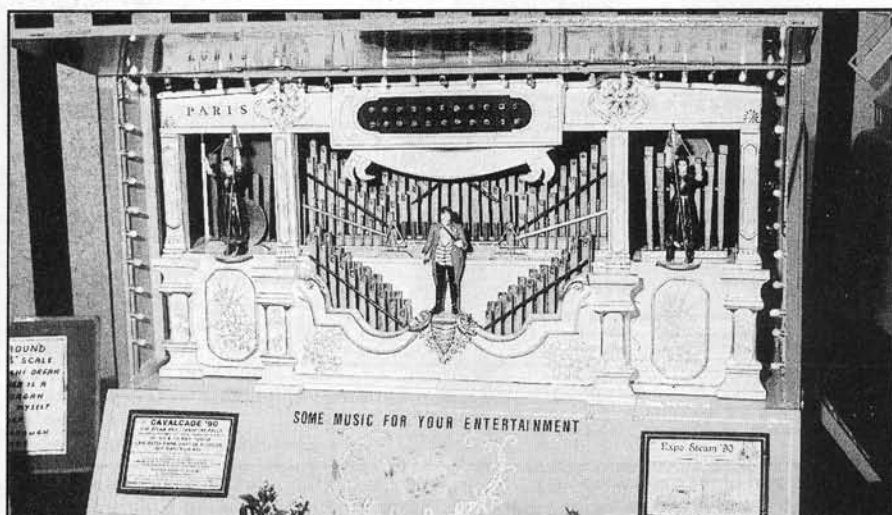
A very wide range of drawings and parts in 1/24th, 1/16th, and 1/12th scale plus some in 1/8th scale. Several carved organ fronts as castings. Cast figures, horses, cockerels, etc. Living vans and trailers also in the larger scales. The catalogue contains much advice on how to set about making models, including painting and a list of suppliers for basic materials.

A video on the subject is also available from:

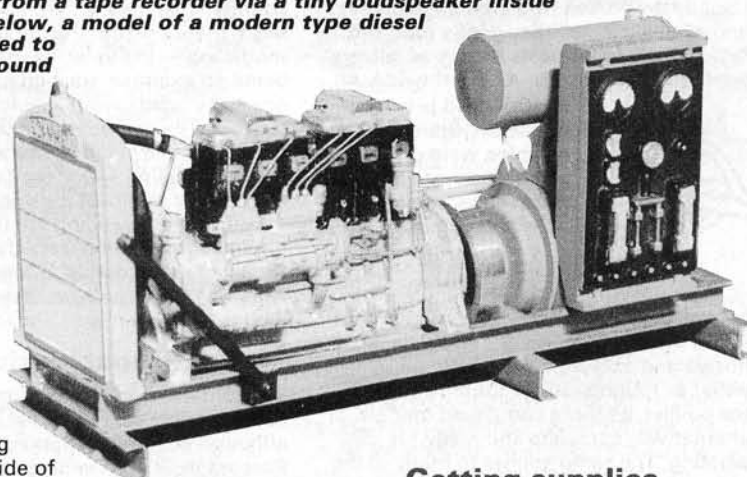
T. C. Darby, 26 Old Kiln Road, Flackwell Heath, High Wycombe, Bucks. HP10 9NR. Telephone. 0628 523375.

There may well be other suppliers of drawings and parts for large scale models and there certainly are others supplying models in 1/76th scale.

For many years the subject of fairground modelling and how to go about it has remained something of a closed book to many. It is hoped that the information supplied in this article will assist those interested in making a start on a fascinating subject and possibly open a way to a new theme for some who have never before had sufficient information to be able to consider this side of model engineering.



An attractive and well painted model of a fairground organ. The music in this case comes from a tape recorder via a tiny loudspeaker inside the organ. Below, a model of a modern type diesel generator used to power fairground machinery.



time-consuming but satisfying side of things. Sometimes it is the thought of the painting that puts people off fairground modelling. The answer is to use simple templates and these days to consider the use of an airbrush. Lighting can be a problem for some modellers but here again everything is catered for. Complete kits are available and these include some simple modules; a booklet is available explaining how to light the various models.

Getting supplies

The subject of fairground modelling is so vast that it cannot be covered in a single chapter in *World of Model Engineering*. The best idea will be to contact one of the two suppliers (both, incidentally, require a stamped addressed envelope) if you wish to receive a supply. It is however possible to give readers some idea of which dealer can supply which as their range differs completely.

More from Carousel Crafts; this cockerel casting also comes in a variety of scales.



Whilst every care has been taken in compiling this list of suppliers of model engineering equipment etc. it

is almost inevitable that mistakes will creep in. Apologies are therefore made to anyone who is not included.

ACORN MACHINE TOOL CO. (1936) LTD.
The Causeway, Egham, Surrey, TW20 9AN.
Tel: 0784 434226

All types of machining facilities including gear cutting to order. Also stock a large range of spares for Atlas Lathes.

S.S. ADAMS,
12 Queensbury Terrace, Cummertrees,
Annan, Dumfries, DG12 5QF.
Tel: 04617 215

Precision engineering of all types carried out to the order of customers.

ADAMSON AND HEATH,
P.O. Box 74, Paddock Wood, Kent, TN12 6DW.

Tool for adapting an off hand grinder into a belt sander.

ADDPRESS,
3 Laurel Close, Furnace Green, Crawley,
West Sussex, RH10 6QE.

High quality measuring equipment, (micrometers Verniers etc) available by post.

ALLMODELS ENGINEERING LTD,
91 Manor Way, Ruislip, Middlesex, HA4 8HW.

Tel: 0895 674126

Stocks of machines and hand tools suitable for model engineering and professional use.

ALLSPEEDS LTD,
Royal Works, Clayton Le Moors,
Accrington, BB5 5LP.
Tel: 0254 235441

State of the art inverter drives for three phase machinery allowing it to work on single phase electricity. The range includes speed controllers.

AKRON TOOLS,
46 Rickmansworth Road, Pinner, Middlesex, HA5 3UN.
Tel: 081 429 0551

Small high quality accessories for machining purposes. Also diamond dressers for dressing grinding wheels.

A.R. ENGINEERING,
Unit 5 Haigh Road, Parkgate Industrial Estate, Knutsford, Cheshire.
Tel: 0565 53199

Perspex cases for models made to order or material supplied for home use.

ARGUS SPECIALIST PUBLICATIONS
Argus House, Boundary Way, Hemel Hempstead, HP2 7ST.

Arguably the largest publishers of hobby magazines in the world. Also considerable stocks of constructional drawings.

ARRAND ENGINEERING,
The Forge, Knossington, Leicestershire,
LE15 8LN.

Tel: 066 477 586
Specialists in high quality lathe tooling particularly boring equipment of which they have a particularly wide range.

ARIAN SERVICES,
195 Gate Road, Penygroes, Llanelli, Dyfed,
SA14 7RW.

Tel: 0269 844987
Can supply ready made or self assembly track for small passenger carrying railways.

ASSET OPTICS
Coventry Point, Market Way, Coventry,
CV1 1EA.

Half eye magnifying spectacles for close up work.

R.A. ATKINS LTD.,
Normandy, Guildford, Surrey.
Tel: 0483 811146

Stocks of machines and tools of use to the model engineer, including the Myford range of lathes and milling machines.

AXMINSTER POWER TOOL CENTRE,
Chard Street, Axminster, EX13 5DZ.
Tel: 0297 33656

Stockists of the most comprehensive range of machine tools and accessories. Apart from supplying machinery they also have a large range of spare parts. A mail order service is offered on all equipment with no carriage

SUPPLIERS LISTINGS

charges within the United Kingdom.

T.E. BARRU,
161 Park Road, Teddington, Middlesex,
TW11 0BP.

Tel: 081-943 1263

Model locomotives made to order, also kits of parts for some popular models.

BASSETT LOWKE,
Augusta Centre, 99 Sanders Road,
Wellingborough, NN8 4NL.

Stocks of high quality plans for construction of model ships.

B.B.C. MACHINE TOOLS LTD.,
Carlisle, Strathclyde, Scotland.
Tel: 0655 751121

Extensive range of machinery suitable for model engineering purposes.

BIDWELL (MACHINE TOOLS AND EQUIPMENT LTD.),

Unit 2b Benbridge Industrial Estate,
Heybridge, Malden, Essex, CM9 7XP.
Tel: 0621 858150

General stocks of new and used machinery and accessories as well as stocks of hand and machine tools and measuring equipment.

BLACKGATES ENGINEERING,
209 Wakefield Road, Drighlington, Near
Bradford, West Yorkshire, BD11 1EB.

Tel: 0532 853652

Complete model engineering supplier stocking or quickly able to obtain virtually any requirement. The casting range includes several items exclusive to the firm such as a range of steam locomotives and a power hacksaw. Copper boilers and parts thereof including a wide range of flangeplates.

BOHLER,
Tel: 07666 2652

Suppliers of high quality low voltage small power tool range. Items include a drill, jig saw, belt sander etc. Obtainable through suppliers in this country.

BOOST ELECTRICAL ENGINEERING,
351a Whitehorse Road, Croydon, Surrey,
CR0 2HS.

Tel: 081-665 6631

Three phase converters and other electrical equipment suitable for use in the workshop.

BRANDBRIGHT LTD.,
The Old School, Cromer Road, Bodham,
Near Holt, Norfolk, NR25 6QG.

Tel: 026 370 755

Narrow gauge garden railways models and equipment specialist.

BRUCE ENGINEERING,
Hollow Tree, Riverside, Penny Lane,
Walton Bridge Road, Shepperton, Middlesex, TW17 8NF.

Tel: 0932 245529

A wide range of models including boilers of interest mainly to the marine modeller. Stockist of the Stuart range of stationary engine kits. Specialities are some particularly well engineered finished models and a range of cylinder hones.

BRUNEL ENGINEERING,
Maple Works, Northgate, White Lund Estate, Morecambe, Lancs LA3 3AZ.

Tel: 0524 843270

Suppliers of a large range of castings for various models which include, locomotives, wagons, traction engines in various scales, and stationary engines. The majority of the models available are unique to the firm.

D AND P BURKE TOOLMAKERS,
27 Woodstock Road, Victoria, Australia.
Tel: 61-3-807-6316

The diamond tool holder. A specially designed toolholder to enable tools to be ground at the

correct angle.

CALDO OILS LTD.,

St Helens.

Tel: 0744 813535

All types of oils available. Including cutting lubricants and light machine oils for machinery.

CAMDEN MINIATURE STEAM SERVICES,
13 High Street, Rode, Somerset, BA3 6UB.
Tel: 0373 830 151

An incredibly large stock of books on all subjects of interest to the model engineer and the full sized transport enthusiast alike. Also drawings and castings for some projects including a traction engine and hot air engine.

MIKE CHANEY,
116 Vicarage Road, Chelmsford, Essex,
CM2 9BT.

Tel: 0245 260096

Supplies of models and equipment suitable for garden railways in the smaller scales, particularly narrow gauge.

CASTLE BOILERS,
23 Claremont Avenue, Clitheroe, Lancs,
BB7 1JN.

Tel: 0200 22326

All types of boilers for the model engineer as well as stocks of copper sheet and tube.

CAWTHORNE AND SON LTD.,
Corporation Street, Nuneaton, CV11 5AG.
Tel: 0203 641212

Draughting equipment specialists, a particularly useful piece of equipment being proportional dividers.

CHEDDAR MODELS,
Sharpham Road, Cheddar, Somerset, BS27 3DB

Tel: 0934 744634

Specialist model copper boiler builders. Also manufacture and supply the puffin steam plant for model boats.

CHESTER MACHINES,
Trellyniau Fawr, Hendre, Mold, CH7 5QW.
Tel: 0352 741560

Can supply a combined lathe and milling machine of unusual design with 420mm centre height.

CHRONUS LTD.,
95 Victoria Street, St Albans, Herts.
Tel: 0727 832793

Large range of model engineering materials and equipment from machines to metal. Special lines include a range of carbide tipped tools.

CROMAR WHITE,
Unit 25, Hightown Industrial Estate, Crow Arch Lane, Ringwood, Hants, BH24 1ND.

Tel: 0425 471398

Suppliers of everything required for a miniature railway from 3 1/2 to 10 in gauge. (Callers by appointment only).

C.J. PRECISION MODEL ENGINEERING,
Unit 11, Hope Mills, Brimscombe, Stroud,
Gloucestershire.

Full machining and boilermaking services.

J.G.S. CLARKE & CO.,
The Old School, Love Lane, Denbeigh,
Clwyd, LL16 3LT.

Tel: 0745 813118

Suppliers of a range of exclusive designs and castings of model locomotives. Also specialise in ready constructed models and easy to assemble kits. They also supply driving and passenger trolleys in the same form.

CLERKENWELL SCREWS,
109 Clerkenwell Road, London, EC1R 5BY.
Tel: 071-405 6504

As the name suggests specialist in screws, nuts etc. A very old established firm from London's watch and clockmaking area, an extra wide range of screws etc. of all sorts is kept in stock,

and in particular small sizes such as tiny metric and BA are available.

COLUMBIA METALS LTD.,
19 High Street, Earls Barton, Northants,
NN6 0JG.

Tel: 0604 810317

Suppliers to industry of non ferrous metals and willing to supply to model engineers. A particularly large selection of various bronzes and brasses in all sizes, including special free machining bronze and non dezincing brass. Also a range of stainless steels for various applications.

COMPASS HOUSE TOOLS,
High Stret, Rotherfield, East Sussex, TN6 3LH.

Tel: 0892 852968

General range of small tools with a special selection of high quality measuring equipment in particular the larger size micrometers and vernier gauges.

COWELL SMALL MACHINE TOOLS,
Ravens Green, Little Bentley, Colchester, Essex, CO7 8TA.

Tel: 0206 251792

Manufacturers and suppliers of a range of machinery suitable for the smaller workshop. These include lathes, a milling machine and a jigsaw. The 90CW lathe is adapted to be particularly suitable for the horologist and accessories are available for this side of the hobby.

CRAFTS FOR FOUR SEASONS,
1120 Melton Road, Syston, Leicester, LE7 8HG.

Tel: 0533 607242

Many small tools in stock but in particular the firm specialises in the requirements of the clockmaker.

C.R.B. ENGINEERING,
Unit 609, 49 Greenwich High Road, London, SE10 8JL.

Tel: 081-692 7513

Makers of copper boilers for all types of models.

C.Z. SCIENTIFIC INSTRUMENTS LTD.,
P.O. Box 43, 1 Elstree Way, Borehamwood, Herts, WD6 1NH.

Tel: 081-953 1688

Importers of the Hobbymat and Prazimat lathes and milling machines. Also keep stocks of micrometers and other items.

DEVON CLOCK KITS,
Albion Hill, Exmouth, Devon, EX8 1JS.

As the name suggests the firm specialises in clock kits of which there is a whole range. The kits are available in several forms from more or less basic material to ready polished simple assemblies. They are members of the British Horological Institute.

JOHN DOYLE,
Proskairm, Dean Row, Wilmslow, SK9 2BY

Tel: 0625 528484

Makers of copper boilers for locomotives, traction engines etc. Prices on request.

D.J.B. ENGINEERS,
17 Meadow Way, Bracknell, Berks, RG12 1UE.

Tel: 0344 423256

16mm to the foot and similar scale garden railway equipment.

ESSEL ENGINEERING,
23 Cavell Road, Billericay, Essex.

Tel: 0277 659774

In particular, suppliers of the Hobbymat range of lathes and milling machines. They make special accessories for the machines which they also supply. Other machinery including the Myford range is also stocked.

ESSEX SMALL STEAM ENGINEERING,
108 Snakes Lane, Woodford Green, Essex, IG1 7HY.

Tel: 081-559 1382

Manufacturers and suppliers of a whole range of equipment for miniature railways, including track, signals, locomotives etc.

FAN AND MOTOR CENTRE,
65 Sidney Street, London, E1 2EU.

Tel: 071-347 3710

Suppliers of electrical motors of all types both new and second hand. They also stock starters etc. The range is very extensive and constantly changing but the needs of the model engineer

can usually be met.

FLAPSTOCK LTD.,
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Tel: 0286 713631

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FRIOG MODELS,
New Inn, Friog, Fairbourne, Gwynedd, LL38 2NX.

Tel: 0341 2500

Major suppliers of models and equipment for smaller gauge garden railways.

FROST AUTO RESTORATION TECHNIQUES LTD.,
Crawford Street, Rochdale, OL16 5NU.

Tel: 0706 58619

Basically as the name suggests the firm supplies to the motor repair industry. They do however stock a range of tools etc which are suitable for many model engineering applications and which are not generally available elsewhere.

GABRO ENGINEERING LTD.,
Hilton Road, Cobbs Wood Industrial Estate, Ashford, Kent.

Tel: 0233 622214

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G AND M TOOLS,
The Mill, Mill Lane, Ashington, Sussex.

Tel: 0903 892510

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GRAHAM ENGINEERING, (MIDLANDS) LTD.,
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Tel: 021 525 3133

The firm stocks a most extensive range of machinery and small engineering tools as well as woodworking equipment. It is probably fair to say that as far as tooling is concerned there is little that cannot be obtained from Graham Engineering, including spare parts for many makes of machines. They market the famous "Alpine" range of equipment as their own line.

GRAHAMS MACHINERY SALES,
Deva House, Sealand Industrial Estate, Chester.

Tel: 0244 376764

Main Myford distributors, also stock some second hand machines and a range of small tools.

GRATECH SERVICES,
17 Uplands Way, Springwell Village, Gateshead, NE9 7NQ.

Tel: 091 416 3626

Narrow gauge garden railway specialist, supplying models and equipment.

HEGNER U.K.,
Unit 8, North Crescent, Diplocks Way, Hailsham, Sussex, BN27 3JF.

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Tel: 081-300 9070

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Tel: 0582 20711

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Tel: 0992 582573

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Tel: 0622 691308

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Wide range of machinery, hand tools, nuts, bolts etc as well as stock materials such as steel, brass, bronze and some boiler fittings, paints and other modelling supplies.

NORMAN SPINK

52 Highfield Lane, Newbold, Chesterfield,

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Tel: 0246 277010

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Makers of copper boilers for locomotives,

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Suppliers of B.C.A. universal milling and jig boring machines and also new and used machine tools and equipment.

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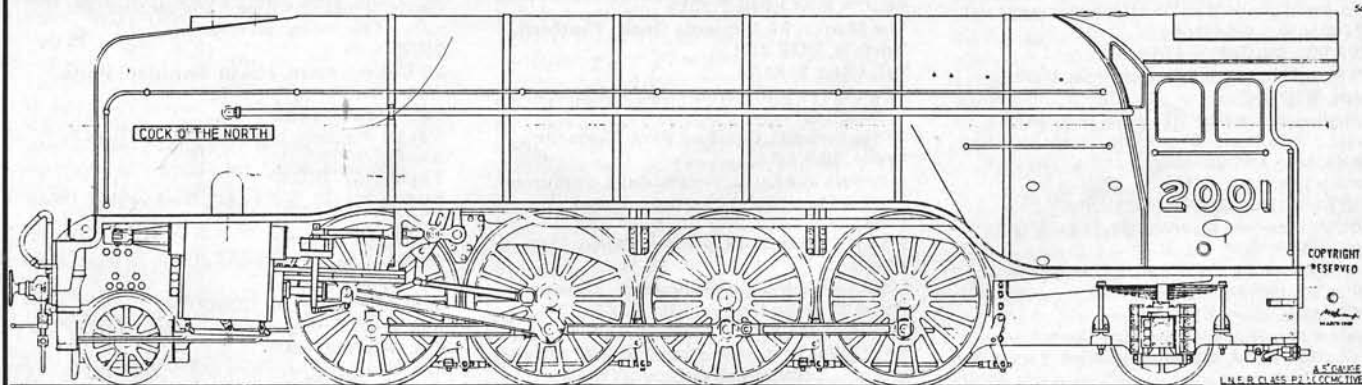
Specialists in welding accessories including clamps, shields etc plus some other engineering equipment.

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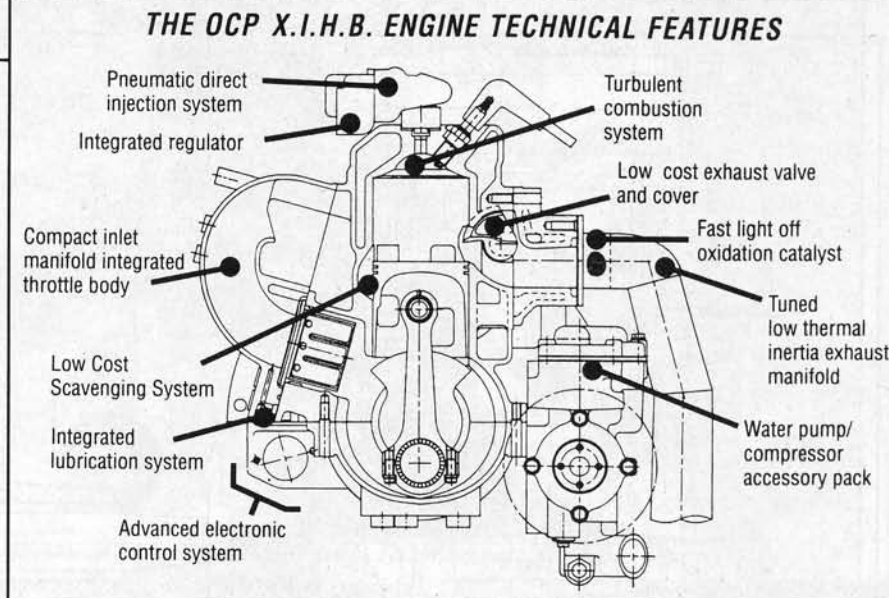
TELEPHONE 0778 346565

While steam reigns undisputed king with many model engineers, the internal combustion engine has its own strong following. They make fascinating and challenging models . . .

That the interest in the internal combustion engine continues to grow amongst model engineers is not surprising. It is something that many in the hobby have been brought up with and so are fairly familiar with the working of such an engine. At the moment, as far as the model press are concerned, there are few new designs coming through to reflect this interest. This is no fault of the editors; they, as a rule, only print what they receive in the way of articles and for some reason people seem to fight shy of designing new internal combustion engines.

Fortunately authors like Edgar Westbury and others left us with a handsome legacy of designs to make and these can often be adapted to meet one's needs. At least one firm, Woking Precision Models, markets a fairly wide range of drawings and castings, whilst a number of others also offer the odd model or two.

Generally speaking, unless a model internal combustion engine is being designed for a boat or aircraft, it must be agreed that it has little practical use, although some modellers have made engines for locomotives and the odd one has been made for a road vehicle. At first glance it would seem that, no matter what it is for, all internal



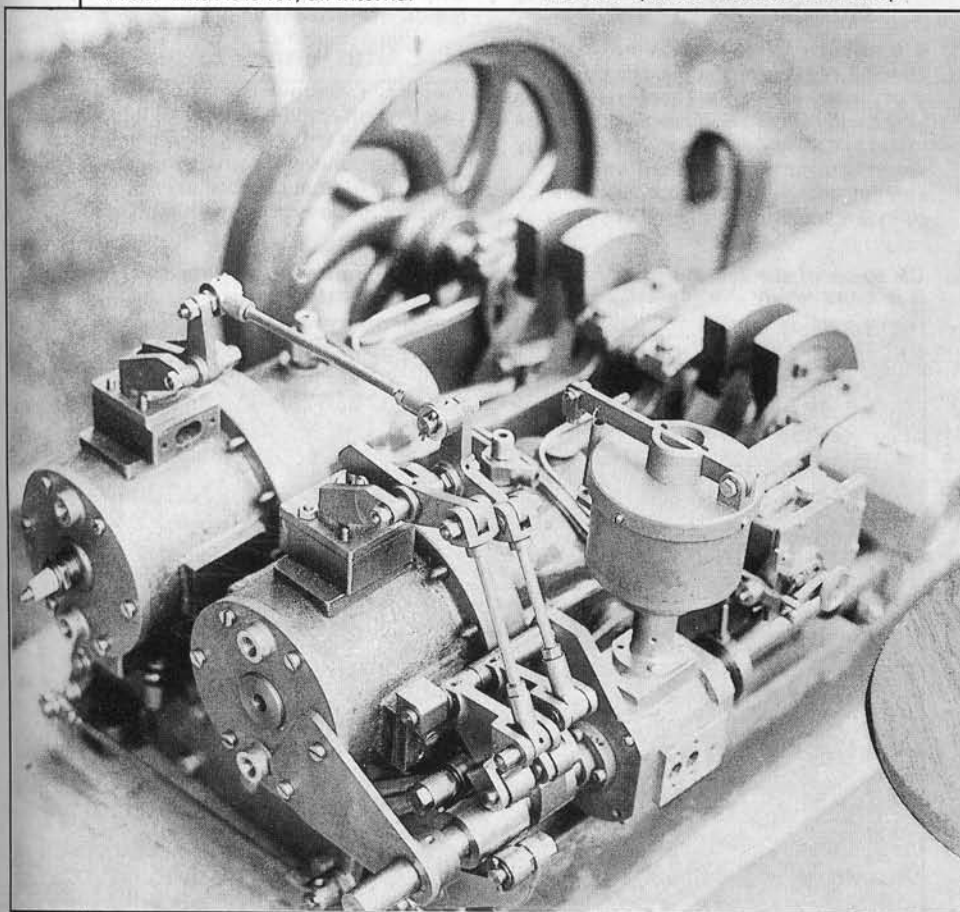
THE MORE MODERN WAY

combustion engines are virtually the same the only difference being the number of cylinders. This is not so. Let us look at the various models that can be made.

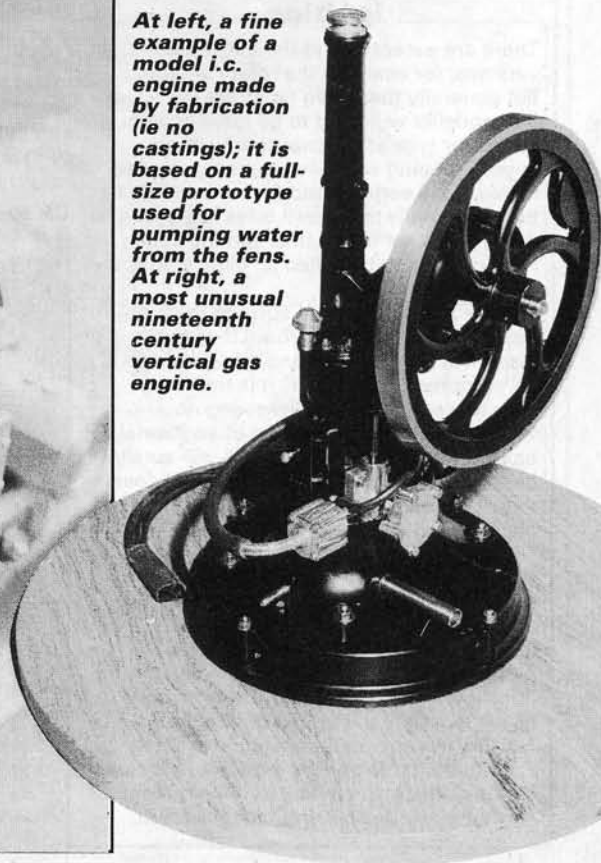
The two-stroke

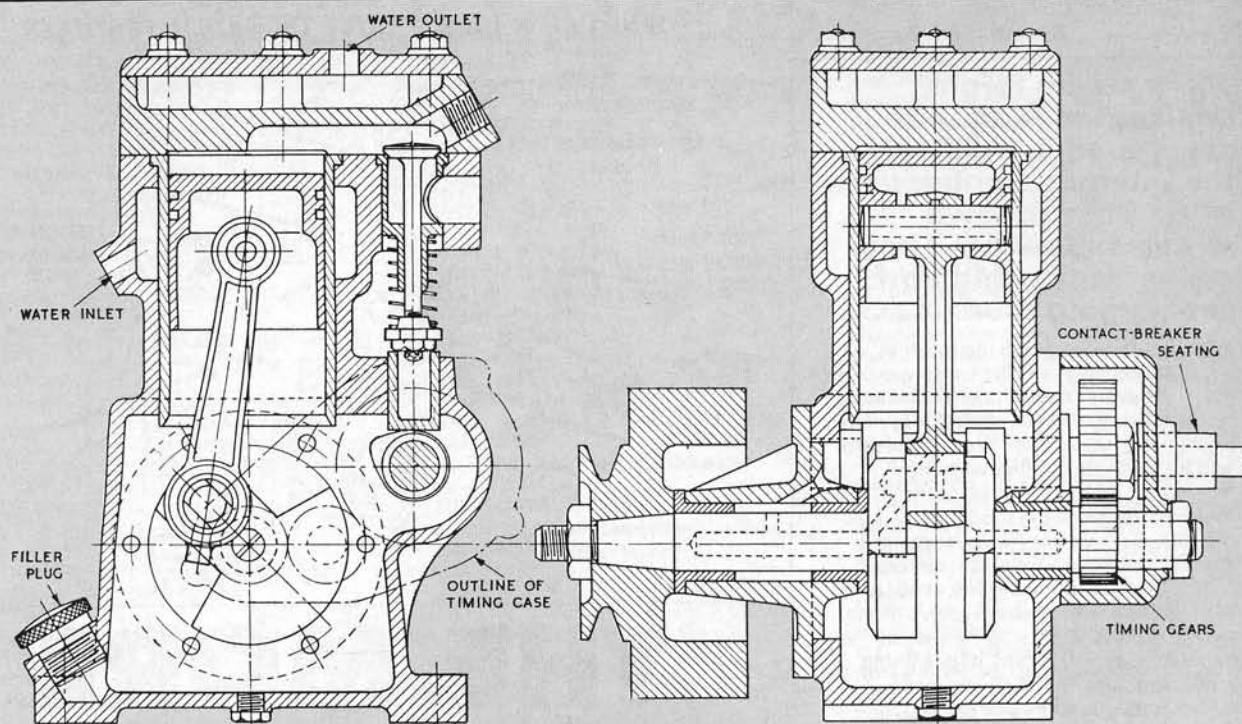
This type of engine is about as simple as anything could be. It works by the fuel which has been mixed with air, being drawn down by the piston and transferred into the cylinder chamber on the up

stroke, via the crankcase. After it is used to push the piston down it exhausts and a fresh supply is taken in. No valves are used, the efficiency relying on the tolerances to which the engine is built. Because the fuel is transferred via the crankcase it becomes difficult to supply oil to the crank and bearings so the usual method is to add some form of lubricant to the fuel. The method is very common and small motor cycles, lawn mowers, etc, are frequently built with two-stroke engines.



At left, a fine example of a model i.c. engine made by fabrication (ie no castings); it is based on a full-size prototype used for pumping water from the fens. At right, a most unusual nineteenth century vertical gas engine.





WHIPPET S.V. PETROL ENGINE. 10 c.c. capacity, 1 in. bore x $\frac{3}{4}$ in. stroke

The Otto cycle

The Otto cycle, or four-stroke, engine is the type we usually have in the car and is almost invariably used on all large engines. In this case there are two valves per cylinder (more on modern cars). The inlet valves open and allows fuel and air to be sucked in. It is taken down the cylinder and then up again and compresses, at which point it fires. This drives the piston down and as it comes up again the exhaust valve opens and allows the spent fuel out.

Ignition

There are exceptions to the above two versions, for example the rotary engine, but generally these two types are the ones the modeller will need to be familiar with. Whatever type of internal combustion engine is being used we are going to need to cause the compressed fuel to burn, and burn so rapidly that it will drive the piston down. Whether or not that burning action is so rapid as to be called an explosion is a mute point.

There are two ways of burning the fuel. It can be compressed so hard that sufficient heat is generated and this is known as 'compression ignition'. It is the principle on which the diesel engine works. Secondly, some form of additional heat can be applied. All readers will surely be familiar with the spark plug which does this. It is timed to give a hefty spark as the piston reaches the top of its stroke.

We need a couple of other things to get the spark — a coil that will give a nice high tension and a condenser to hold the charge plus a battery. Unfortunately although we can make miniature spark plugs of the right size the coil and condenser will almost certainly be over-scale as will possibly the timing device. This matters not one bit if the engine is being run purely for one's own pleasure, but can create problems when fitted into a model, particularly if it is a flying model aircraft.

An alternative is to use a glow plug. The plug is connected to a battery and a wire heats up to fire the fuel. The action of the glow plug is not, of course, anywhere near as fast as that of a sparking plug but it does save room and weight and can be quite useful. The idea was used in full-size but with a slight variation, notably in the method of heating the device. So if we make a glow plug engine we are not getting too far away from the prototype...

Number of cylinders

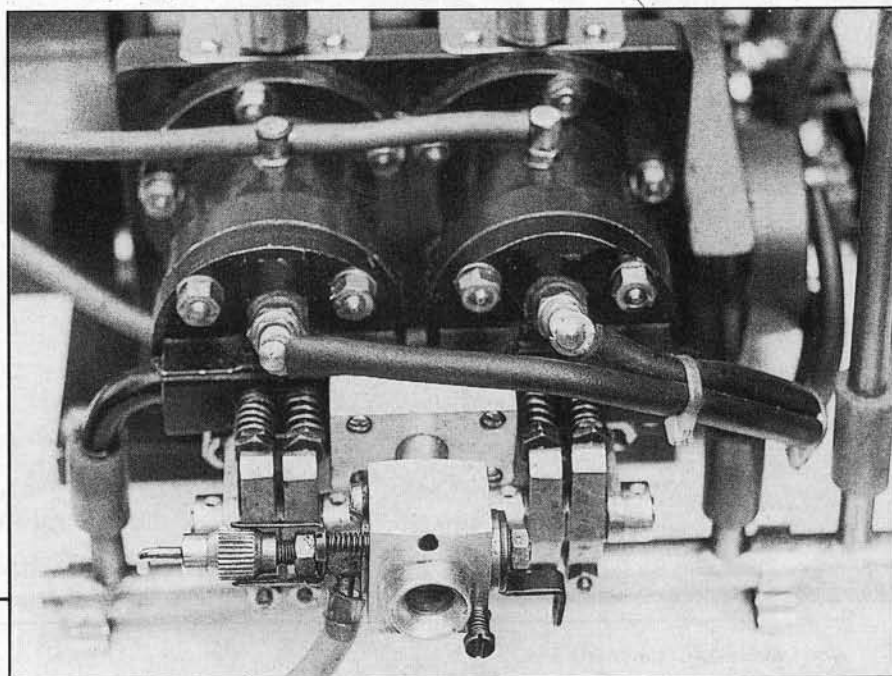
It is probably fair to say that the majority of small engines are single cylinder. This saves many problems. There is no reason why multi-cylinder engines should not be made and, if so doing, then it is generally easier to use the Otto cycle. Two-stroke engines become a little complicated as the cylinders multiply. With the Otto cycle

engine the cylinders are closed off and this means that the crankcase can be made to accept all the cranks and hold a quantity of oil to lubricate things. With a two-stroke each crank must be cased as a separate unit in order to allow the transfer of the fuel. A thing not always realised is that, where a multi cylinder internal combustion engine is made, in nearly every case the cranks will be set at one hundred and eighty degrees, whereas with a steam engine it will be ninety or a hundred and twenty.

Stationary Engines

Whilst all the above refers to internal combustion engines in general it is mainly aimed at the type of engine which is to be fitted in a vehicle of some sort, or is designed for that purpose even if the constructor does not use it that way. The

Close-up of the front end of twin cylinder engine made by the late Sid Hamon; it is completely fabricated, even the plugs being scratchbuilt.



so-called stationary engine is designed as a small unit, frequently quite portable, to drive machinery or a dynamo via a belt. Such engines were made in their thousands and were to be seen earlier this century on farms and in small factories everywhere.

Their place has now been taken by electric motors, but there is a very large body of enthusiasts who preserve such engines. Many of them were supplied as sets of castings and could be made on a reasonable sized lathe, so in a way they were a form of model engineering in full-size, if that make sense! There are a number of models of such engines available as drawing and casting sets and they make excellent projects for the model engineer.

Gas and oil engines

Many stationary engines burnt gas or oil instead of petrol; these invariably work on the four-stroke system. There is sometimes a difference to the more normal internal combustion engine in as much as the inlet valve will frequently open under atmospheric pressure. Like the petrol and diesel engine the fuel needs to be mixed with air before admission but firing is often by some form of heat plug or tube. This is heated externally with a flame. Other engines of this type will use the more normal electric sparking device generally supplied by a magneto.

Air cooling

With fuel being burnt in this way, there are high temperatures involved and this in itself will cause the engine, particularly the cylinder, to heat up. Add to this the friction of the piston sliding up and down inside the bore and it is a recipe for disaster if something is not done about it, which means some form of cooling system. The simplest is air cooling which simply

A stationary engine, this one from commercially available castings.

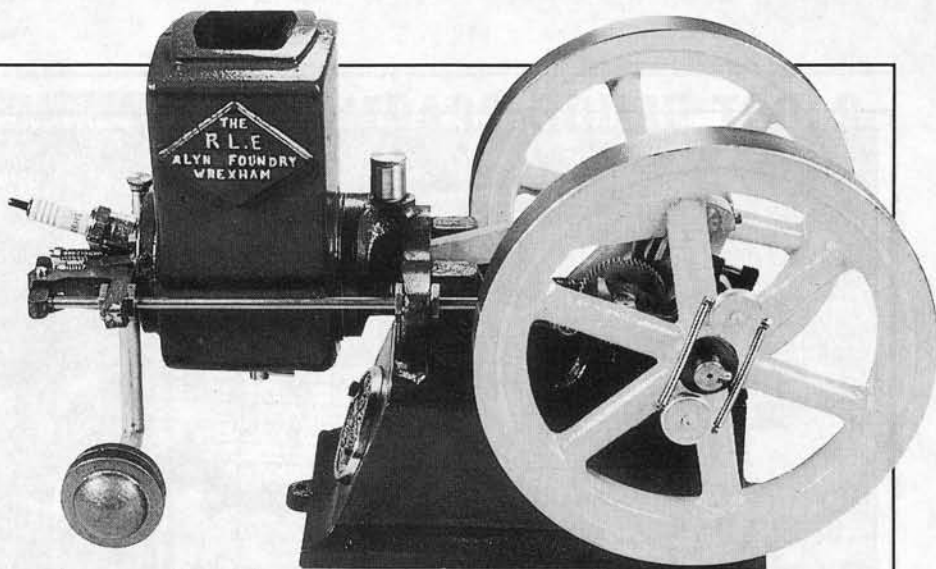
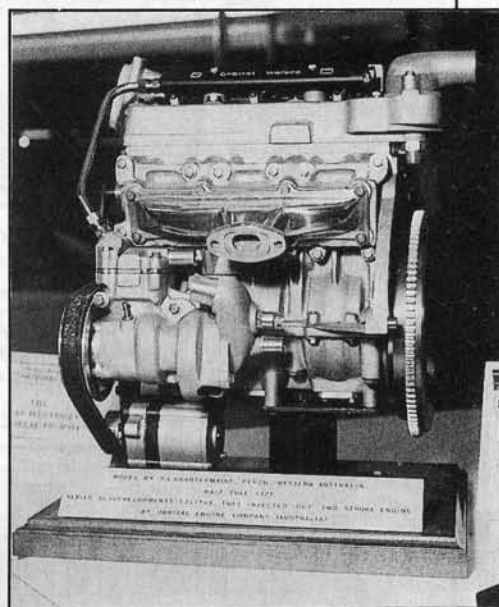
means allowing cool air to blow round the outside.

Generally the outside of the cylinder and sometimes the crankcase as well will have a number of fins cast or machined in. The transfer of air through these cools things down and it is a system commonly used on motor cycles. Most of the time the motor cycle engine is running the vehicle will be travelling, allowing more cool air to pass through the fins and so adding to the cooling effect. Where a stationary model is made this additional drawing in of air does not happen and so the fins must be devised to give an extra cooling area.

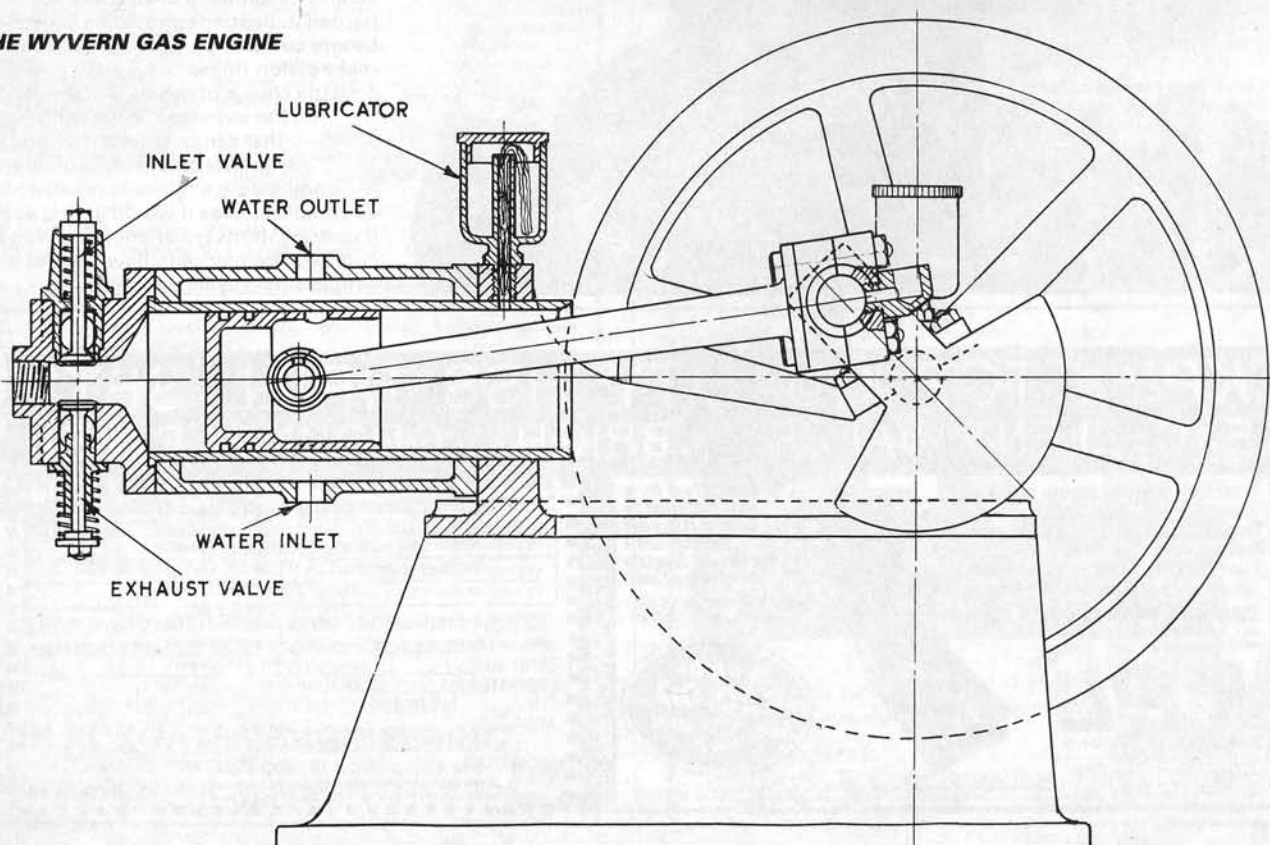
Water cooling

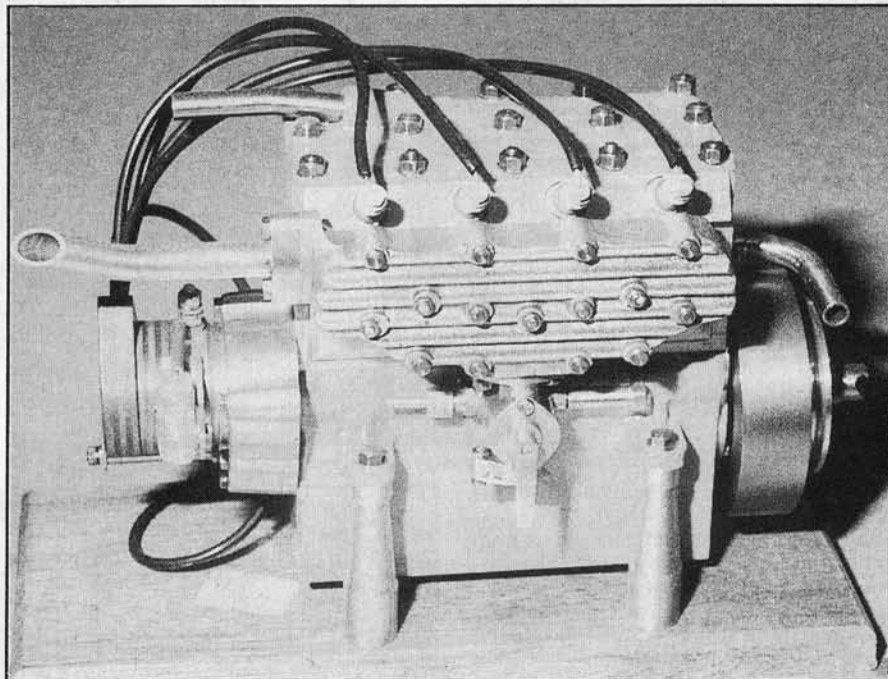
Having in mind the difficulties involved in air cooling there is much to be said for a system of water cooling with as large an

Half-size model of an Orbital 2-stroke engine by T. L. Quartermaine of Perth, Australia; compare with sketch of full-size on title page.

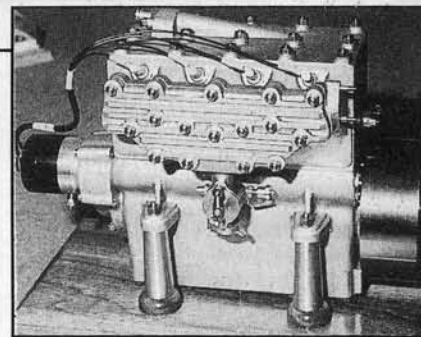


THE WYVERN GAS ENGINE

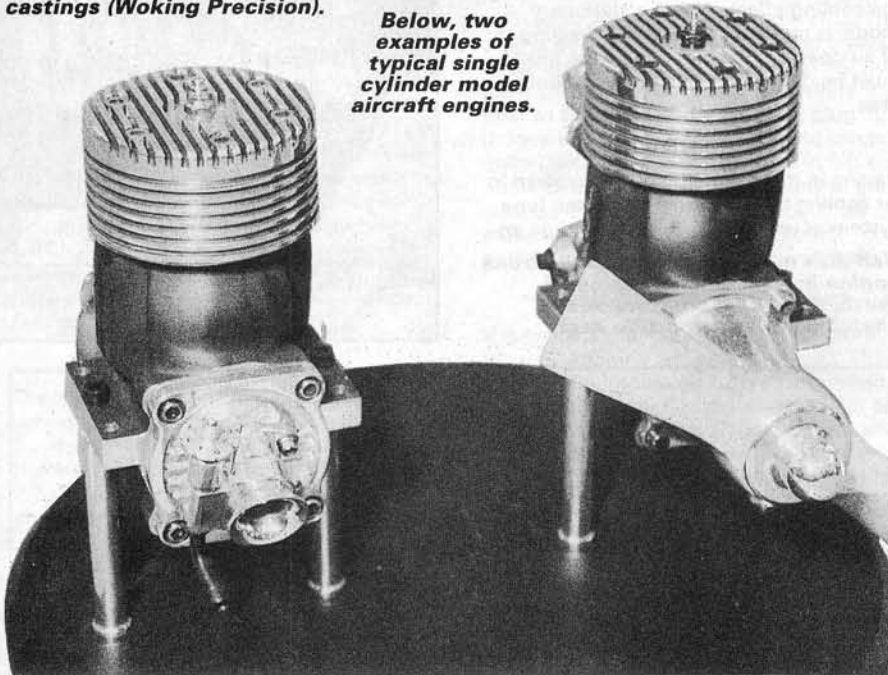




Above and above right, two examples of 'Seal', a popular 15cc capacity 4-cyl engine from Model Engineer plans (PE 20) and commercial castings (Woking Precision).



Below, two examples of typical single cylinder model aircraft engines.



amount of water as possible being used. This involves machining or casting some form of water jacket round the cylinder and, if possible, arranging for a means to transfer cool water into the water jacket. Fortunately the latter is not so difficult. Water will transfer itself once it gets hot and if an engine is used in a boat then all that is required is a couple of tubes going into the water on which the boat is being sailed. In the case of stationary engines it is sometimes possible to add a water jacket to the cylinder block, it being made as a separate unit and slid over.



Materials

Aluminium is used fairly extensively for making small internal combustion engines, although if weight is not a problem mild steel or cast iron will do just as well. Cylinder liners are best made of cast iron which can be purchased in stick form. Pistons can be made of aluminium and fitted with cast iron piston rings. These are easily made by machining a piece of cast iron to the right internal and external diameters and parting off. A quick tap on a chisel will make the required gap to allow the ring to be fitted. If possible the gap should be at an angle of about forty five degrees. If the engine is very small then fit a cast iron piston without rings.

Crankshafts can be of steel and, if possible, that should be a high carbon steel which has been hardened. If mild steel is used then it is an idea to case harden it. Bearings should be bronze and bronze can also be used successfully to make piston rings.

As the choice of design will depend on the individual there is little more that can be offered in the way of advice. Making models of internal combustion engines is nowhere near as complicated as it would at first appear. It is straightforward enough for even a comparative novice to have a go at a simple single cylinder engine.

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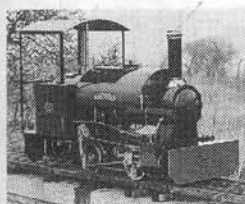
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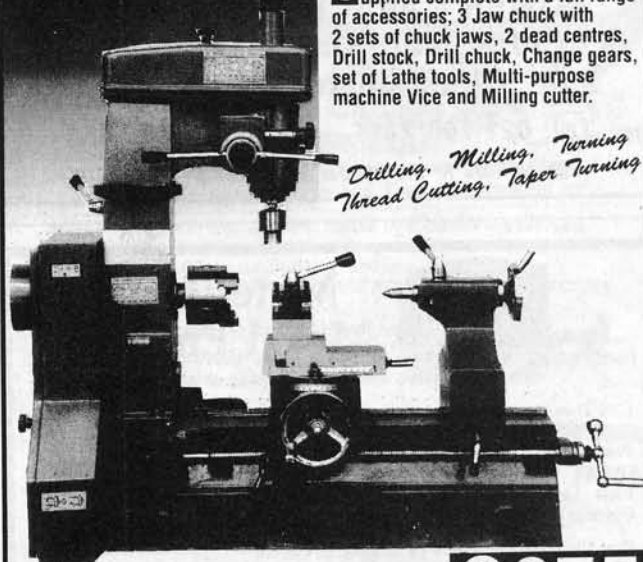
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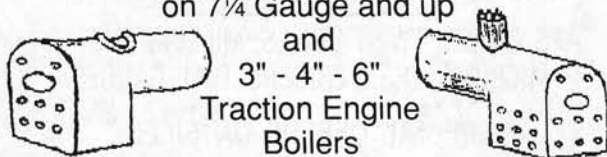
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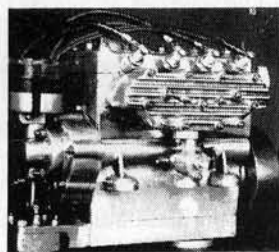
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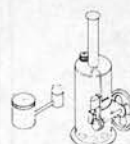
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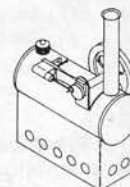
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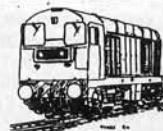
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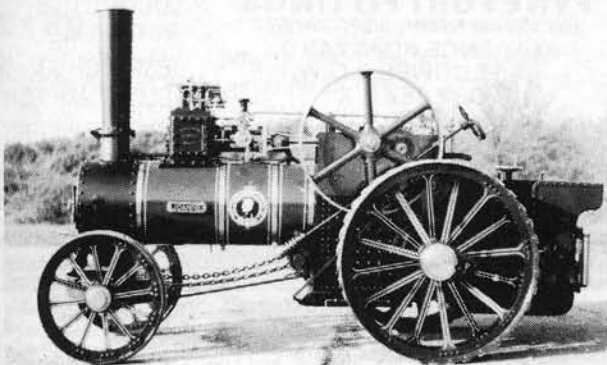


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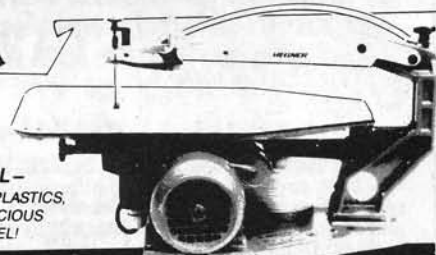
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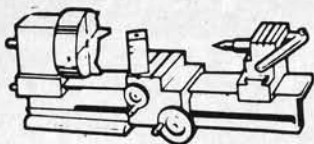
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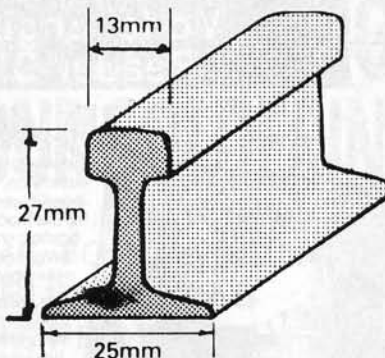
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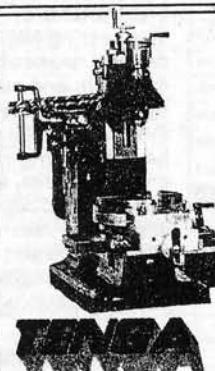
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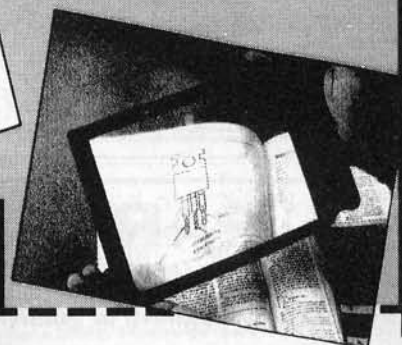
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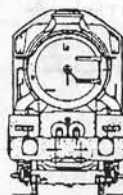
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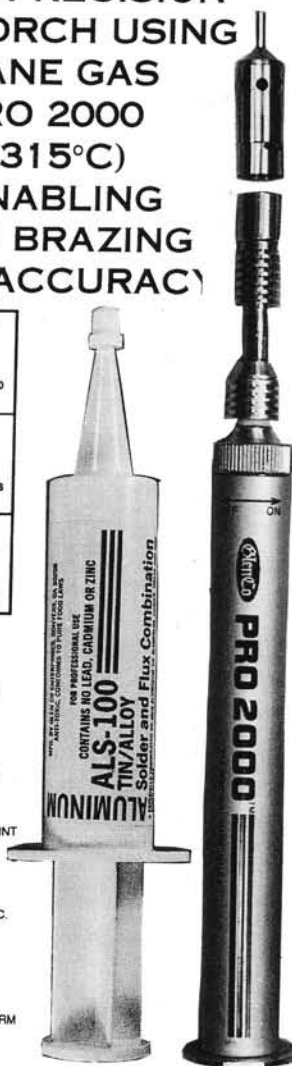
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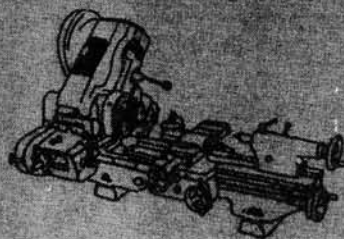
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